CLAIMS:

1. A non-naturally occurring intein or cleavage or cleavage and splicing moiety having splicing activity and/or controllable cleavage activity.
2. The intein of claim 1 comprising a truncated intein.
3. The intein of claim 1 wherein the cleavage activity is controllable by varying at least one physical condition or by varying at least one chemical condition or by varying both at least one physical condition and at least one chemical condition.
4. The intein of claim 3 wherein the cleavage activity is controllable by varying pH.
5. The intein of claim 3 wherein the cleavage activity is controllable by varying temperature.
6. The intein of claim 3 wherein the cleavage activity is controllable by varying ion concentration, presence or absence.
7. The intein of claim 3 wherein the cleavage activity is controllable by at least two of: varying pH, varying temperature, and varying ion concentration, presence or absence.
8. The intein of claim 3 wherein the cleavage activity is controllable by varying temperature and pH.
9. The intein of any one of claims 1-8 wherein the intein is also a mutant intein.
10. The intein of claim 9 wherein the intein is obtained from random mutagenesis of a truncated intein, followed by selection based on growth phenotype.
11. The intein of any one of claims 1-10 wherein the intein has C-terminal cleavage.
12. The intein of any one of claims 1-11 wherein the intein is a truncated Mtu intein.
13. The intein of any one of claims 1-11 wherein cleavage rate is determined by an enzymatic reaction and not a chemical reaction.
14. The intein of any one of claims 1-11 wherein the intein has the endonuclease domain deleted.
15. The intein of any one of claims 1-14 wherein the intein is a truncated Mtu intein with the endonuclease domain deleted, and V67L and/or D422G mutation(s) or any intein having a D to G mutation in a location corresponding to residue 422 of the full-length Mtu intein, by sequence homology or any intein having a V to L

mutation in a location corresponding to residue 67 of the full-length Mtu intein, by sequence homology.

16. The intein of any one of claims 1-15 containing the C-terminal histidine.

17. A protein including an intein of any one of claims 1-16.

18. The protein of claim 17 comprising a polypeptide of interest and the intein.

19. The protein of claim 18 wherein the intein is in an inter-domain region of the polypeptide of interest.

20. The protein of claim 17 wherein the protein comprises a binding protein portion, the intein, and a reporter protein portion.

21. The protein of claim 20 wherein the intein separates the binding protein portion and the reporter protein portion.

22. The protein of claim 20 wherein the reporter protein is an enzymatic assay protein, a protein conferring antibiotic resistance, or a protein providing a direct colorimetric assay.

23. The protein of claim 20 wherein the reporter protein is selected from the group consisting of: thymidylate synthase, ß-galactosidase, galactokinase, alkaline phosphatase, ß-lactamase, luciferase, and green fluorescent protein.

24. The protein of claim 17 wherein the protein comprises a binding protein portion, the intein, and a protein of interest portion.

25. The protein of claim 20 wherein the intein separates the binding protein portion and the protein of interest portion.

26. The protein of claim 17 comprising an external fusion of a polypeptide and the intein.

27. The protein of claim 17 comprising an internal fusion of a polypeptide and the intein.

28. The protein of claim 17 comprising a desired polypeptide and the intein, as either an internal fusion or an external fusion, wherein the intein is located before a serine, threonine or cysteine residue of the desired polypeptide.

29. The protein of claim 17 comprising a desired polypeptide and the intein, wherein the intein and the desired polypeptide are separated by a serine, threonine or cysteine residue.

30. The protein of claim 17 comprising a desired polypeptide and the intein, wherein the C-terminal histidine or asparagine or histidine-asparagine of the intein is immediately followed by the initial methionine of the desired polypeptide.

31. The protein of claim 17 comprising a desired polypeptide and the intein, wherein the initial methionine of the desired polypeptide has been eliminated.

32. The protein of claim 16 comprising a desired polypeptide and the intein, wherein the C-terminal histidine or asparagine or histidine-asparagine of the intein is immediately followed by the second amino acid of the desired polypeptide.

33. The protein of claim 32 wherein the second amino acid of the desired polypeptide is lysine.

34. An isolated nucleic acid molecule encoding the intein or protein of any one of claims 1-33.

35. A vector containing the isolated nucleic acid molecule of claim 34.

36. A host cell transformed with the vector of claim 35.

37. The vector of claim 35 comprising a plasmid.

38. The cell of claim 36 comprising *Escherichia coli*.

39. A method for producing a protein comprising subjecting a protein of any one of claims 17-33 to cleavage conditions.

40. A method for producing a protein comprising preparing a protein of any one of claims 17-33 and subjecting the protein to cleavage conditions.

41. A method for producing a protein comprising preparing a fusion of a polypeptide and an intein of any one of claims 1-15 and subjecting the fusion to cleavage conditions.

42. The method according to claim 40 or 41 wherein the cleavage conditions allow about 90% cleavage in about 4 hours at 37°C; about 12 hours at 25°C; or about 150 hours at 4°C.

43. The method according to claim 40 or 41 wherein the cleavage conditions allow about 90% cleavage in about 6-8 hours at 23°C.

44. The method according to claim 40 or 41 wherein the cleavage conditions allow cleavage at physiologic pH.

45. The method according to claim 44, wherein the pH is between about 8.5 and 6.0.

46. The method of claim 40 or 41 wherein the protein or fusion is prepared recombinantly.

47. The method of claim 41 wherein the protein or fusion is prepared by preparing a vector containing DNA encoding the protein or the fusion, transforming a host cell with the vector, and expressing the DNA in the host cell.

48. A method for purifying a desired protein comprising preparing a fusion polypeptide comprising a binding protein portion, an intein portion as claimed in any one of claim s 1-16, and a desired protein portion, binding the fusion to a binding moiety, subjecting the intein to cleavage conditions, and separating the desired protein.

49. The method of claim 48 wherein the binding of the fusion to the finding moiety is binding the fusion to an affinity matrix, and the separating includes subjecting the affinity matrix to a pH and/or temperature shift and eluting the desired protein.

50. A method for preparing an intein according to any one of claims 1-16 comprising subjecting intein DNA to random mutagenesis, expressing the intein DNA with a reporter and screening for elevated intein cleavage activity using growth medium and varying conditions.

51. The method of claim 50 wherein the random mutagenesis comprises amplifying intein DNA using a polymerase.

52. The method of claim 50 or 51wherein the intein DNA codes for a truncated intein.

53. A method for screening for enhanced intein cleavage activity comprising subjecting intein DNA to random mutagenesis, expressing the intein DNA with a reporter and screening for elevated intein cleavage activity using growth medium and varying conditions.

54. The method according to claim 53, wherein cleavage rate is determined by an enzymatic reaction and not a chemical reaction.

55. The method of claim 53 or 54 wherein the random mutagenesis comprises amplifying intein DNA using a polymerase.

56. The method of claim 553 or 54 wherein the intein DNA codes for a truncated intein.

57. A method for screening for reduced intein cleavage activity comprising subjecting intein DNA to random mutagenesis, expressing the intein DNA with a reporter and screening for reduced intein cleavage activity using an assay with a chemical that plays a part in a cell metabolic and/or biochemical cycle.

58. The method of claim 57 wherein the random mutagenesis comprises amplifying intein DNA using a polymerase.

59. The method of claim 57 or 58 wherein the intein DNA codes for a truncated intein.

60. The method of any one of claims 57-59 wherein the chemical is trimethoprim, the assay is a trimethoprim gradient, and the cycle is the folic acid cycle.

61. A method for determining amino acid residues in an intein that play a role in cleavage activity comprising deleting and/or changing amino acid(s) in the intein to obtain an altered intein, preparing a fusion of the altered intein and a reporter and selecting for reduced intein cleavage activity using an assay with a chemical that plays a part in a cell metabolic and/or biochemical cycle and/or selecting for elevated intein cleavage activity using selective growth medium and varying conditions.

62. The method of claim 61 wherein the fusion is prepared by expressing the altered intein with the reporter.

63. The method of claim 61 or 62 wherein the deleting and/or changing amino acids in the intein is by random mutagenesis.

64. The method of any one of claims 61-63 wherein the amino acid(s) being deleted or changed precedes a conserved amino acid selected from the group consisting of serine, cysteine and threonine.

65. The method of claim 64 wherein the amino acid(s) that is deleted and/or changed is immediately preceding the conserved amino acid.

66. The method of any one of claims 50-65 wherein the reporter is thymidylate synthase.

67. A recombinant molecule encoding a fusion protein containing nucleic acid encoding an intein according to any one of claims 1-15 where the intein is

inserted in a specific region in the protein such that activity of the intein is retained in a control-specific manner.

68. The recombinant molecule according to claim 67, where the intein is inserted in one or more of a N-terminal domain, a C-terminal domain, a joining segment, an interface between the N-terminal domain and the joining segment or an interface between the joining segment and the C-terminal domain.

69. The recombinant molecule according to claim 68, wherein the intein is inserted N-terminal to a zinc finger region or Cys rich region.

70. The recombinant molecule according to claim 69, wherein the intein is inserted in the interface between the joining segment and the C-terminal.

71. A recombinant molecule encoding I-*Tev*I fused with an intein such that, upon expression of the fusion construct, I-*Tev*I is expressed in amounts suitable for protein purification.

72. The recombinant molecule according to claim 71, comprising pET28-I-*Tev*I::SM::CBD plasmid.